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THE RIDDLE OF DYSLEXIA

ATMANAND SHARMA
M.A.,M.Sc.,Ph.D

EDUCATIONAL PSYCHOLOGY UNIT
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING
SRI AUROBINDO MARG
NEW DELHI-110016

CONTENT

PART I

PART II

PART I

Introduction

1981 was the year of the disabled. A greater attention was paid by specialists from different disciplines to help the disabled medicaly, educationaly, vocationaly and even jobs were reserved for them. While some of the disabilities such as blindness, deafness, mental retardation, orthopaedic handicap, severe emotional disturbance, speech impairment are easily understood and appreciated, but very little is known about the disabilities most important to education, namely, learning disabilities (LDs). The term, LDs, is not a broad term to cover children experiencing all kinds of learning problems. LDs have their own specific population of disabled children.

Learning Disabilities of greater concern to the school going child, his teacher, his parent are: (1) Dyslexia (difficulty in learning to read in spite of adequate intelligence and proper instructions, implies neurological dysfunction); (2) Dyscalculia (difficulty in manipulating mathematical symbols and mastering computation, usually as a result of neurological, disorder); (3) Dysgraphia (difficulty in performaing motor movement needed for writing); (4) Hyperactivity (behaviour unnecessary to the situation or task at hand, and disruptive to others - a motor disturbance which is not an emotional problem). Thus language problems, arithmetic problems and distractability are three learning disabilities which need attention of the LD specialists and

neurologists. They affect 3 to 15 percent of 6-14 age children. Of all LDs, 'dyslexia' needs greater attention because of the importance of language in all school learning.

A Case

Anil's very presence was disheartening and annoying to the teacher. The teacher, an enormous lady in an authoritarian manner, leaned forward to address the parents of the child. She looked at 4-year-old Anil, who sat neatly and smartly dressed in the front row but expressionless as usual. Dear Sir, she said, her voice rising in emotion, 'I can't believe you could have such a child, after those two brilliant girls.'

It happened nearly ten years ago, but Mrs. Madhu and Mr. Vinod K. Gupta still shudder when they recall the scene. The teacher's indictment pierced through them like the pointed needle. How indeed could the mother, a teacher, the wife of an IAS, and the mother of two brilliant daughters, have a son who was failing reading readiness in KG class.

Anil is one of the estimated 3 to 5 percent children with dyslexia, an LD that impedes one's ability to process the symbols of written language. Dyslexia's wide-ranging symptoms include inadequate speech, difficulty in learning and remembering printed words, reversal of letters

or the sequence of letters in words, uncertaintly as to right or left handedness confusion about directions in space or time and illegible handwriting.

Definition

Myklebust (1968) defines 'childhood dyslexia' as a language disorder that precludes acquisition of meaning from the written word because of a deficit in ability to symbolise. It may be endogenous or exogenous, congenital or acquired after birth. The limitations in read language are demonstrated by a discrepancy between expected and actual performance in reading. These limitations derive from dysfunctions in the brain, manifested by disturbances in cognition. They are not attributable to sensory, motor, intellectual or emotional impairment nor to inadequate teaching or deprivation of opportunity.

Poor Reading Is Not Dyslexia: Among the conditions that cause poor reading achievement are lack of opportunity, inadequate teaching, low intelligence, emotional disturbance, poor hearing or vision, and bilinguity. Although the brain of dyslexia children reacts as it does in normal children who are confronted with meaningless information, the differentiating factor is whether there is a deficit in gaining meaning from the written word. If there is no such deficit, the reading disability is not

designated as a dyslexia. Similarly, poor spelling ability characterises the written language of dyslexics but spelling disorders per se are not necessarily the result of dyslexia. Analysis of types of spelling errors often reveals the type of Dyslexia present, whether the dyslexia is predominantly auditory or visual (John and Myklebust - 1967).

Agnosia Is Not Dyslexia: Agnosia is the inability to attach meaning to what is heard, seen or touched; in other words children can hear, see, say or write words but they cannot attach meaning to them. In 'auditory agnosia' sounds are not comprehended; the individual hears what is said but cannot convert what is heard into words: the speech sounds cannot be symbolised so meaning is not gained. This is a language disorder, inability in use of this spoken words. 'Visual agnosia' is an inability to attach meaning to what is seen. The words on the page can be seen but cannot be coded; no meaning is gained. 'Tactile Agnosia', is a corollary of auditory and visual agnosia, in which meaning is not gained from what is touched. This might take the form of a verbal agnosia in blind children who cannot learn the meaning of braille symbols. A similar disorder is encountered in deaf children who see lip movements of the speaker but cannot attach meaning to these movements.

Apraxia Is Not Dyslexia: An aprasia affects ability to convert 'symbols' into their equivalent 'motor form'. When 'verbal-symbolic expressive' language is disturbed, it is called Aprasia. Expressive aphasia is a form of apraxia; the individual knows what he wants to say, but because of a symbolic disturbance he cannot utter the words. Likewise Dysgraphia an analogus condition in written language is also verbal aprasia.

Major Types of Dyslexia

Four major types of dyslexia are recognised: (1) Inner language dysleixa; (2) Auditory Dyslexia; (3) Visual Dyslexia, (4) Intermodal Dyslexia.

Inner Language Dyslexia: is the most severe form. There are deficits in both auditory and visual-verbal processing. The child sees graphemes and transduces them into their auditory equivalent, evidenced by his ability to 'read' aloud. But despite these perceptual and transducing skills, he cannot learn to read because cognitively the level of meaning is by passed. So far as input and output are concerned, information is precessed well, but language is more than input and output. This information must be coded, and coding assuming meaning. In inner language dyslexia the break occurs at this level in the information processing system. Because information cannot be coded, what is read/seen is not words; there is no meaning. This kind

of dyslexia appears most commonly in autistic and Educable Mentally Retarded (EMR) children, but its existence in children who are otherwise less handicapped is not ruled out.

Visual and Auditory Dyslexia: Both auditory and visual cognitive processes must show integrity if reading is to be achieved normally. When the child learns to read he must be able to both visualise and auditorize words. Gates (1900) observed a long time ago that in the early stages of learning to read the child often moves his lips, saying the words to himself - sometimes even saying them aloud. He both 'hears' and 'sees' the words. A dyslexia can occur because of a disorder in either or both, the 'seeing' and 'hearing' phases of the reading process; the visual dyslexic cannot cognitively visualise graphemes properly and the auditory dyslexic cannot cognitively auditorize them properly. The deficit is in language ability to symbolise and code the read words. This deficiency in auditory processing is not receptive aphasia because the disorder is in the auditorization of graphemes and does not involve comprehension of a spoken language.

In most dyslexic children the primary disturbance seems to appear in the ability to relate phonemes to graphemes information of words. The auditory language from, the most basic form, serves as a foundation for the visual-

verbal form. It is difficult to learn to read unless the auditory form has been acquired.

Visual Dyslexia: Children who have visual dyslexia usually can identify letters by name; often they may write profusely but what they write is jargon and non-readable. They are capable of discriminating the letters visually (which means perceptual processes exist but they are mainly non-verbal) but cannot read them as meaningful words. Therefore, as is true in all dyslexia, the deficit is in attainment of meaning, in encoding words on the page as words. In this sense visual dyslexia is visual-verbal agnosia. Typically, this is not a disability in differentiating the visual components of words, although such a difficulty is present in some children, but in visualization of them for coding; even though the components are differentiated, they cannot be symbolised. This is a significant form of child dyslexia.

Intermodal dyslexia: Reading is a very complex process. It involves the functioning of various parts of the brain. Four types of cognitive functioning are necessary for successful learning to read: (1) integrity of auditory processes, (2) integrity of visual processes, (3) integrity of the processes required for transmodal learning and (4) integrity of the processes required for

integrative learning. The auditory and visual dyslexia are sustained by disturbance at the intra-neuro-sensory learning. Hence an auditory dyslexia can occur without a visual dyslexia, and vice-versa. In many cases of childhood dyslexia there may not be any deficit in intra-neuro-sensory learning. Both auditory and visual cognitive processes are achieved, but one cannot be transferred into the equal form of the other.

Intra-auditory processes serve as the fundamental basis for 'learning to read'. But, developmentally visual processes in relation to the auditory must become operational at an early stage. After the auditory and the decoding from the auditory to visual has been established the task is to learn to reverse this process and decode from the visual to the auditory. Finally, to achieve the highest level of reading, the child must process the graphemes only visually; he must learn to read by processing on a visual to visual basis. He must be able to read with only occasional interaction with auditory processes. In the early stages of learning to read, there is in essence total dependence on transducing graphemes into their equivalent spoken forms. But gradually the successful reader is less and less dependent on the auditory. Although never achieved with perfection, he is able to bye pass the auditory and read by only visual process.

Dyslexia Syndrome

As one views retrospectively the data from a number of dyslexics, a syndrome can usually be discerned.

1. There is a language disorder that impedes one's ability to process the symbols of written language.

2. Reading ability is not commensurate with mental age and with the opportunities offered him to learn to read.

3. Poor ability to relate letter and letter sound, so spelling often appears bizzare and the child's spelling often bears little or no relationship to the stimulus word.

4. Right-left discrimination problems.

5. Dischronometrical disturbances - a basic disturbance in time as an aspect of a symbolic language disorder.

6. Sequencing difficulties.

7. Visual motor coordination problems that often begin at the level of body image disturbances and are not infrequently also accompanied by gnosic disorders.

8. Sontaneous and creative writing poor.

9. Often bizarre maturation - much further advanced in one are and quite slow in others.

10. Often general language deficits - dysphasic in character.

11. Audio-visual and-or Visual-auditory integration impaired as well as other integrational aberrations.

12. Conceptualization deficits.

13. Poor time concepts.

14. Achievement in arithmetic higher than in language arts area.

15. Topographical disturbances evidenced in map reading, directional orientation etc.

DYSLEXIA IS INDIVIDUAL
EVEN WHEN NOT SEVERE
MAY BE ENOUGH TO
BLOCK HIS CAREER

However, an important fact is that all dyslexics will not have all these symptoms and some have different ones as well. Therefore one cannot make any valid generalisations. Due to individualistic nature of dyslexia the programmes are prescribed on an individual basis and the problems involved in the individual's audio-visual verbal processing system are delineated prior to programme formulation.

This deceptive nature of dyslexia has made it one of the least understood affections. Educationists (and parents too) speculate that it may be easier to cope with a visibly handicapped child than with one who has a more subtle disability. People are tolerant of the blind man with the cane, they may even go out of their way to help him cross the street. But if the child looks

perfectly normal, has average intelligence and unimpaired hearing and vision, yet can't read, sympathy is not forthcoming. Worse still in many cases neither is help rather he is punished.

Incidence: According to western experts dyslexia affects 3 to 15 per cent of all school children to-day. A middle school education at most a vocational certificate thereafter marks the end of a dyslexia victim formal education. Where his academic talents or career interests lie is largely irrelevant. With the proliferation of technology, dyslexic people will be turning up in increasing numbers on the unemployment line.

No wonder new tests of dyslexia may reveal that the employees with poor performance are dyslexic. In a competitive world, even though "their disability may not be too severe but it may be severe enough to make them stagnate in their job."

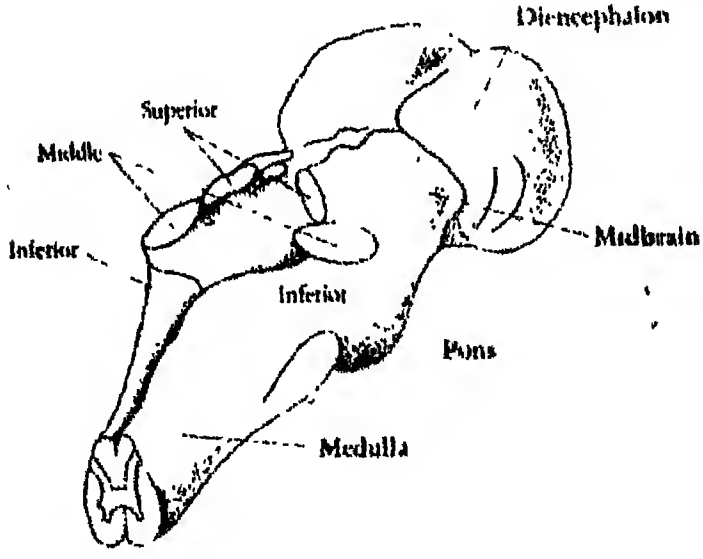
THE BRAIN AND DYSLEXIA

The central nervous system (CNS) has two major components: (1) spinal cord, (2) brain. The brain is comprised of three major parts: (a) brain stem, (b) cerebellum, (c) cerebrum (cerebral cortex). The major functions of the brain stem involve the integration of several visceral functions (for example, control of heart and respiratory rates) and control of

a variety of motor reflexes. The cerebellum coordinates the efferent, voluntary muscle system and plays a role in controlling balance and coordinated muscle movements. The cerebrum is concerned with conscious functions language, thinking and reasoning processes, memory etc. The brain stem and the cerebral cortex are important in understanding learning disabilities.

Brain Stem.

FIGURE The three connections between the cerebellum and the brain stem

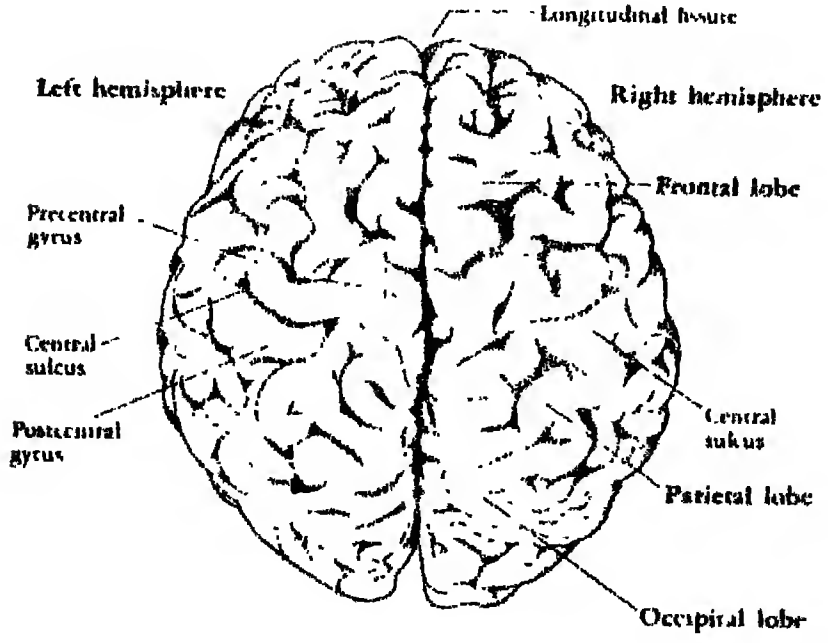


The brain stem is composed of four regions which have discrete functions. These are (a) the medulla oblongata, (b) pons, (c) midbrain, and (d) diencephalon. The medulla, a continuation of the

spinal cord, has nuclei (cell bodies) and tracts (axons) which have functions in controlling respiration and the cardiovascular system. The pons is associated with sensory input and output flow to the face, and is located at the upper limit of the medulla. The midbrain has a huge pair of tracts which carry messages down from the cerebral hemispheres and it has the sensory tracts which start in the spinal cord and go to the brain stem. The midbrain is associated with wakefulness or the conscious state of the entire brain. Some theorists attribute attentional deficits in learning-disabled children to breakdowns in the midbrain (Dykman et al., 1971). The diencephalon, the upper portion of the brain stem, is a major center for the passage and integration of sensory information. (see figure)

Cerebral Cortex

FIGURE Left and right sides of the cerebral cortex



The cerebral cortex is divided into right and left hemispheres which are connected by the corpus callosum. This is a large tract of fibers which connects the two sides and keeps them at least reasonably well informed as to their mutual activities and interests (Mountcastle, 1962). The surface of the cerebral cortex has many convolutions, an economical spatial arrangement for cramming many cells into a relatively small area. The convolutions have been labeled as gyri (ridges), sulci (valleys), and deep sulci(fissures). Maps of the brain have been drawn to mirror these ridges and valleys. Some of the gyri and sulci have been linked to behavioral functions. In other cases, the functional role of the area in affecting behaviour is not known (see figure).

The organisation of activities in the cortex differs for various behaviors. Certain functions, such as vision and audition, are controlled by both the left and right sides of the cortex. Motor movements, such as of the arms and legs, are coordinated by both sides, but in a contralateral fashion; the left side of the brain controls the right side of the body, while the right side controls the left side of the body. There are some skills that are not represented in these fashions, but are controlled largely

by one hemisphere. For example, across cultures there is a great preponderance of right-handedness and left-hemisphere dominance for language. About 93 percent of the adult population is right-handed and about 96 percent has left-hemisphere dominance for speech and language functions (Curtis et al., 1972). The right hemisphere is purportedly more in control of making complex visual discriminations and processing of nonverbal and perceptual information, such as music and mathematical symbols, than the left hemisphere (Milner, 1962).

It should be noted that for many years it was assumed that only the cerebral cortex was involved in the learning process. While most of the foregoing discussion is focussed on the role of the cerebral cortex in governing behavior, remember that other parts of the nervous system between the spinal column and the cortex are involved in learning. The brain is organized vertically as well as horizontally (Thompson, 1967).

The cerebral cortex has been divided into four major regions. These are the frontal, temporal, parietal, and occipital lobes. There are major land-marks used to set some of the boundaries for individual lobes. For instant, the lateral sulcus is the land-mark to separate the

frontal from the temporal lobes, while the central sulcus separates the frontal from the parietal lobe.

Hinshelwood (1895)

APPROACHES TO DYSLEXIA

James Hinshelwood began publishing in 1895 on a mysterious affliction known as acquired word-blindness, sudden loss of the ability to read. His summary monograph, Congenital World-Blindness, was published in 1917. Hinshelwood had an explicit theory of the role of the brain in reading, and he tested it clinically. His theory was that there must be separate places in the brain for (a) visual memory of the general everyday type; (b) visual letter memory; and (c) visual word memory. If that were true, Hinshelwood said, then it should be possible to find pure cases of each. He set about collecting cases from his own practice and through contact with other physicians.

Hinshelwood suggested that the 'angular gyrus' region of the left hemisphere was a critical site in dyslexia, as a visual word storehouse. He was correct in recognising the critical region although wrong in hypothesing why it was critical. The region is not a 'visual word storehouse', instead it is an association area for crossmodal integration (among visual, auditory and kinaesthetic areas of the brain.)

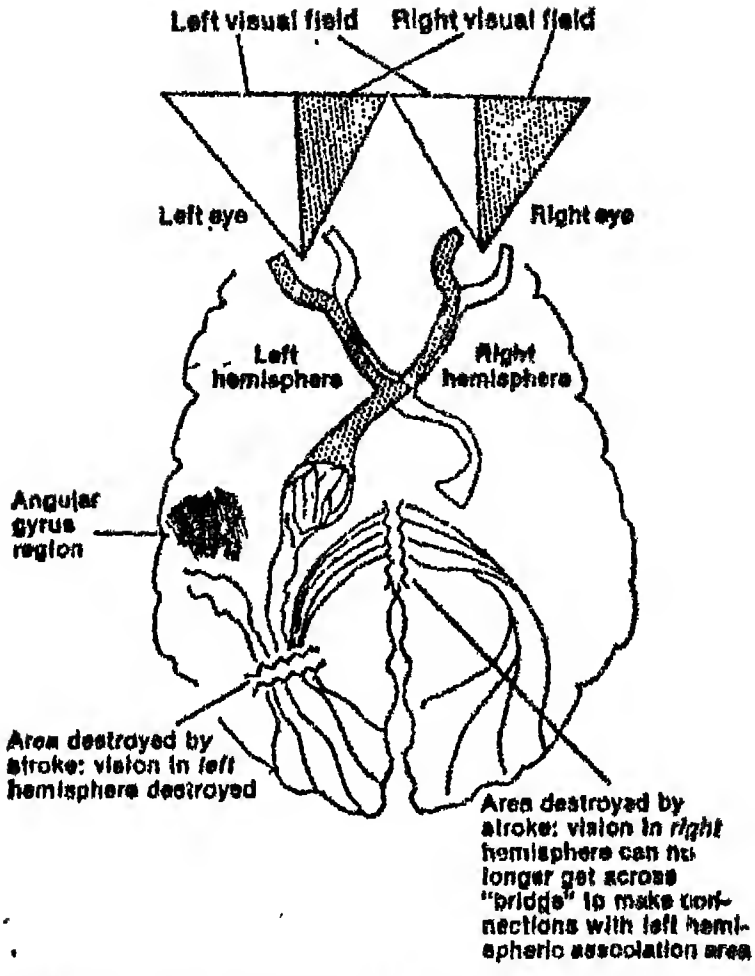


Diagram showing the type of brain damage that can result in the loss of reading ability. If the patient cannot connect words that he sees right-hemispherically with the association area (angular gyrus) in the left hemisphere, then pure reading disability (without agraphia) will result. If, on the other hand, the angular gyrus is damaged, reading disability with agraphia will result. This is the more common condition -- the patient cannot read, write or spell.

Perceptual Deficit Hypothesis (Orton 1925)

In 1925, Samual T. Orton published a paper entitled "Word-blindness In School Children" in the

Archieves of Neurology and Psychiatry. He presented his new theory of dyslexia - one based on the notion of hemispheric imbalance.

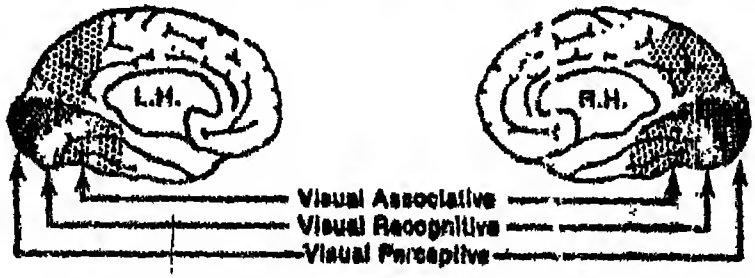
Orton believed that something was wrong with the brains of the dyslexic children, but, unlike Hinshelwood, he thought the disorder to be functional in nature rather than structural. He found an important clue, he thought, in the mirror writing of certain children.

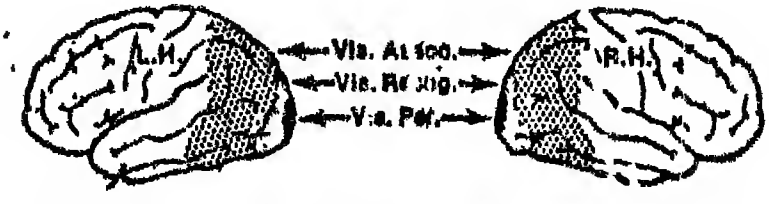
Orton believed that written production were some thing like a 'Print-out' of information stored in the brain. The prevalent view at that time was that the left hemisphere was responsible for the storage and production of language. Less was known about the functions of the right hemisphere, but Orton believed that it reflected the activities of the left. The right hemisphere contained a mnemonic record, a reflected duplicate of information in the left hemisphere. These records could trigger matching motor activity. According to him the reversal letters (d as b) commonly noticed in childrens writing was due to this mnemonic record.

Learning to read and write correctly, then was a matter of learning which hemispheric image to pay attention to. Normally a child learned that the left hemispheric renditions were the correct ones. In some cases, however,

this learning did not develop normally. He recognised three types of cortical tissues. The first, "visual perceptive", were the initial receivers of sensory information. Orton called that cortical level "arrival platform". The next level up, "Visual recognitive", contained brain cells that facilitated visual associations of a limited type. Object recognition occurred at this level, but object meaning could occur at the next level: "visual associative". In this area of the brain connection could be made with other information from sensory and motor areas.

Orton believed that either hemisphere could effectively perform perceptive and recognitive activities.

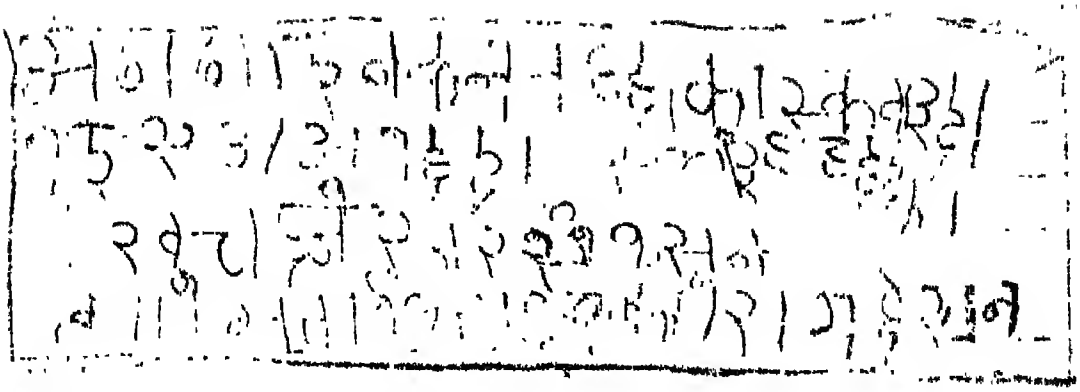




Distribution of three types of cortical tissue. From Orton, Archives of Neurology and Psychiatry, 1925, 14. 582-615. Copyright 1925, American Medical Association. Reprinted by permission.

but that associative activities had to be performed by the left hemisphere alone. His evidence for that belief was neurologically straightforward. Brain injury at the first and second levels did not impair behaviour unless it occurred in both hemispheres. Simple perception and recognition could apparently be managed by whichever hemisphere remained intact. But third-level injury was a different story: damage to the right hemisphere made no difference, but damage to the left hemisphere produced word blindness. To Orton, this suggested 'that the process of learning to read entails the elision from the focus of attention' of the right hemispheric images. When the left hemisphere was unable to perform that critical suppressive function, confusions and delays would result. There would be distortions of the motor output in both speech and writing, interference in the linking of visual symbols and sounds, and subsequent failure to associate sounds and meaning. Orton called the whole disaster 'strephosymb The Greek roots of the term - strepho and symbolon - mean 'twisted signs'.

The writing of two dyslexic children identified in our ERIC supported project "A Longitudinal Investigation Into the Dropout Process and Characteristics of Dropout" are photographed below which illustrates the phenomenon o strepho-symbolia. The writing of a non dyslexic child of the same class is also presented.



इ होने पर जेम्सवाट एक जगह मशीन बनाने
का काम करने लगा। वह मशीनों की
मरम्मत करने में बहुत कुशल था। एक दिन
एक आदमी उसके पास भाप का एक
इंजन मरम्मत के लिए लाया। इस इंजन
को देखकर जेम्सवाट बड़ा खुश हुआ उसने
इंजन खोला और उसकी खराबी मालूम
कर ली। उनको मरम्मत करके उसके
कुछ और सुधार भी कर दिए अब यह
इंजन बहुत अच्छी तरह काम करने लगा। इस

गांधीजी ने किसानों की बुराई
को ठीक करना किया। इसलिए
वे पर काम किया और
उन्हें [illegible] [illegible] [illegible] [illegible]
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Syndrome of Strephosymbolia

Orton described six clusters of disabled behaviou which he believed to represent dominance failure of the left hemisphere. These are as under:

(1) Developmental Alexia: Unusual difficulty in learning to read, but no evidence of accompanying physic mental or emotional abnormality.

(2) Developmental Agraphia: Spatial difficulty i learning to write.

(3) Developmental Word Deafness: Difficulty in recognising the spoken word, delay and distortion of speech, but normal hearing.

(4) Developmental Motor Aphasia: Slow development and disorder of speech, but good understanding of the spoken word. (that is no word deafness).

(5) True Childhood Stuttering: Spasms of the spe musculature which either blocked speech or produced mechanical repetitions.

(6) Developmental Apraxia: Abnormal clumsiness similar to the type of clumsiness exhibited by a right-ha person attempting to use his left hand.

The above syndromes still compriso what many consider the true domain of learning disabilities - as compared to the narrowed domain or reading disability, so often emphasised by schools.

To summarize, Orton's observations of reading retardates who reversed letters in reading and writing provided a popular explanation for reading failure; that the children have difficulty in the perception (discrimination, memory, translation) of visual symbols. Advocates of the "perceptual deficit hypothesis" focus upon directional confusion (Hermann, 1959); difficulties in figure ground perception (Bender, 1938); Strauss and Lehtinen, 1947); deficits in visual analysis and synthesis (Birch & Belmont, 1964); perceptual motor problems (Cruickshank, Bentzen, Ratzeburg and Tannhauser, 1961; Frostig, 1964; Kephart, 1963); and disturbances in optical control (Getman 1965).

However, using the same behaviours others have interpreted reading disabilities as reflections of deficits in attention or organisation of visual arrays, verbal labeling and verbal rehearsal. (Hutson, 1974; Lyle, 1969; Lyle and Goyen, 1968; Vellutino, 1974). At least on the basis of available evidence, it would seem that the role of visual perceptual disfunctions in producing reading retardation has probably been overestimated. Indeed, there is evidence of the role of auditory processes in affecting reading performance and no doubt future work in the area of reading will further delineate their role.

Specific Brain Areas Hypothesis (Penfield 1950)

Penfield and colleagues (1950, 1955), have postulated that speech and language are the responsibility of the Centrencephalic system: a central system which includes three speech centres in the cortex, two in the frontal lobe, and one in the temporal lobe, plus connections with the descending pahway to the spinal cord. Damage to any of these areas in the adult has debilitating effects upon the person's ability to use speech and language.

According to Lennberg (1967), the child's language development until 30 months of age involves his entire brain, with left hemisphere dominance for language beginning to show towards the end of this period. Between ages 3 and 10, language functions are assumed by the left hemisphere alongwith polarization of other behaviours to either the left or right side. It is still possible, however, to reverse this polarisation if the child experiences some trauma. That is, before ages 10 or 11, damage to the left hemisphere which results in language problems can be compensated for by the right hemisphere. It apparently is not easily accomplished, but is possible. By the mid teens, language is definitely localised in the left hemisphere and trauma to this area are not compensated for by the right hemisphere. Lenneberg's findings support to the notion that when a child has difficulty in the acquisition of language skills some brain

area may be directly involved. It also lends support to the Penfields and his colleagues inclusion of the mid brain as part of the speech system.

Deficits In Cross Modal Information Processing
(Birch & Belmont 1965)

Another explanation for reading failure is the difficulty in integrating auditory and visual information. This area was first initiated by the studies of Birch & Belmont (1965), Blank and Bridger (1966), and Blank, Weider and Bridger (1968). They have offered evidence that disabled readers were less able than adequate readers on a variety of tasks which require associating visual and verbal stimuli.

However, many studies concerned with the Cross-Modal Integration Hypothesis have failed to control for intrasensory processing or for the verbal demands placed upon the child. Recently there has been some tendency to move away from concepts involving intra-and inter-sensory auditory and visual processing toward conceptualising stimuli as either involving spatial or temporal features. It is suggested that future learning disability specialists should be sensitive to the spatial-temporal as well as the auditory-visual features of the tasks confronting children.

Attentional Deficits Hypothesis: (Dykman 1970)

Dykman and his colleagues (1970, 1971), have developed a theory of learning disabilities in which the core problem is defined as an attentional deficit. The corresponding neurological structure implicated in this theory is the midbrain, particularly the reticular formation within the midbrain. This subcortical area is deemed responsible for maintaining a state of consciousness and awareness. A disturbance in the midbrain area affects the individual's ability to pay attention. This includes his ability to stay alert, to maintain vigilance and to focus on important stimuli in any given situation. Learning-disabled children are viewed as having an organically based deficit, localised in the midbrain, which affects their ability to maintain states of attention.

This hypothesis of attentional deficit which reflects midbrain dysfunction is based upon extensive laboratory research studies of reaction time, impulsivity and the conditioning of LD children. The children with limited reading skills and excessive motor activity, demonstrate slower patterns in reaction times, different EEG responses, and decreased physiological reactivity when compared to non-disabled children.

Dykman offers additional evidence to support his theory. In one case, evidence is drawn from the effects of drugs upon LD children. Stimulant drugs are believed

to increase childrens' attentiveness, but have no effect on their performance on intelligence tests. The reticular and activating system is thus indirectly implicated.

Development Sequence of Myelination And Cross Modal Integration

Norman Geschwind, a neurologist in his paper "Neurological Foundations of Language" has framed two hypotheses which are quite relevant to understand the learning disability. In his first thesis he links the development sequence of the neurological process of myelination to successive stages of psychomotor and language development. Myelination refers to the process whereby an outer sheath develops to cover and protect nerves. Nervous system is not competely developed when the infants is born andthe areas of the brain which myelinate last are vulnerable to insult for a longer period. The order in which parts of the nervous system myelinate reflects the development of man's brain across centuries. The older parts of the brain from a philogentic view myelinate first. The older part of the brain from a phylogentic view myelinate first. The sensory area which show early myelination include the auditory, visual, and somesthetic cortex which have connections with their adjacent areas but not directly with each other.

The second area to myelinate are the association areas. These areas surround the sensory area, but allow, through long inter connecting fibres, various sensory areas to communicate with each other.

The last areas to myelinate are in the parietal lobe, the angular gyrus, and a spot where the temporal, parietal and occipital lobes meet. These particular areas are regarded by Geschwind as critical to language and, consequently language problems. The angular, gyrus and the occipital parietal temporal lobe junction are presumed responsible for man's ability to make cross-modal associations, that is, to transfer information from one modality, such as vision, to another modality, such as audition. In man, unlike other animals corss-modal associations can be made directly through the association areas without going through the more primitive limbicsystem. This is the anatomical basic for labeling and Geschwin suggests that damage to this area may be one exmlanation for learning disabilities, particularly dyslexia.

His hypothesis is that since this area myelinates last and boys mature more slowly at this stage of development than girls, the over representation of boys in learning disability samples indicates that boys are more likely to have suffered some damage to this area of the brain. Boys are seen as susceptible to damage to slowly myelinating brain centres longer than girls.

Geschwind's hypothesis regarding the critical nature of certain areas in the parietal lobe

particularly the angular gyrus, or the association areas which connect fibre from the occepital, parietal and temporal lobes has been expanded into an area of study referred to as 'cross-modal associations' or 'across modal integration'. The angular gyrus is of particular importance, because its strategic position and connecting fibres allow it to integrate information from all sensory and motor areas. Translating a thought into a motor act is likely to involve this area. One theory to explain learning disabilities is that these pathways or areas are dysfunctional.

There is some support for this Geschwind's hypothesis concerning the importance of angular gyrus in learning disability. Birch Belmont (1964) studied the ability of retarded readers to make auditory, visual, tactile associations. Children with reading problems were last competent than comparison children in making these associations.

Note:- Geschwind, N "Neurological foundation of the language". In H.R. Myklebust (ed) Progress in Learning Disabilities, Vol. I, New York, Grune & Stratton, 1968.

Abnormalities in Cell Layers (Kemper & Galaburda, 1979)

In an article published in Annals of Neurology (1979), Dr. Thomas Kemper and Dr. Albert Galaburda, both neurologists working at Boston City Hospital have opened a new chapter in the approach to dyslexia, by providing physical evidence for the first time to substantiate the neurological theories about dyslexia. The investigators observed abnormalities in the brain of a 20-year-old dyslexic man whose brain has been donated after he died in an accident, using a technique called "Cytoarchitectonics (literally, the way cells are arranged).

To the naked eye, the brain of the dyslexic person looked normal. But by sectioning the brain serially and examining the density, layering, and cell configurations under a microscope, abnormalities in the layer of cells in the left hemisphere, were detected. There were small abnormal convulsions in the temporo-parietal region called "Tpt" (located between the temporal and parietal lobes which form top and sides of the cerebrum).

Several discoveries mistified the doctors. They found the cell of the cortex, the white mantle covering the brain, strewn about haphazardly instead of being arranged in their normally organised pattern. They were also surprised by the presence of abnormally large nerve

cells in the outer most layer of the cortex and by groups of cortical tissue in the white matter of the brain. They also observed abnormalities in the thalamus, an area known to be crucial in language development.

Kemper says their findings lend suppot to Orton's interference theory. "We found that the normal part of the sensory speech area was very small on both (right and left sides). The left side had some normal and some screwed-up parts, (which) fits in with Orton's theories. But you can't generalise from one brain" they caution.

While the left hemisphere was highly irregular, the right one appeared perfectly normal. This suggests that the right held could compete with the left for control of language functions. Galaburda, feels that, "there is no one thing called dyslexia". And since there is no uniform behaviour (associated with the disorder), there is probably no uniform structural abnormality responsible for it." The neuro-psychologists are pursuing the matter with two more brains including that of a 12-year old dyslexic child.

With the increase in public interest, financial support and pledges of more than 250 brains for laboratory research, (many from dyslexic people), such research is at least becoming feasible. It may account for the right hemisphere's interference and thus may provide new evidence for Orton's theory.

PART II

DIAGNOSIS AND ASSESSMENT OF DYSLEXIA

In part I an attempt was made to describe (a) the approaches to dyslexia (b) the nature of dyslexia (c) dyslexia syndrome and (d) major types of dyslexia. All this knowledge of dyslexia is basic in diagnosing and assessing dyslexia.

Purpose of Diagnosis

The question, 'Diagnosis for what'? needs some consideration. Three primary functions of diagnosis are easily noticed: (a) scientific, (b) therapeutic, and (c) moral.

In a scientific venture, categorisation of persons, objects, or events is done to stimulate further thinking about the groups so categorised and to increase our scientific knowledge about those groups. Thus mental patients may be categorised as schizophrenic, maniac - depressive, or neurotic; and their characteristics may be compared and contrasted. Likewise learning-disabled may be diagnosed into major categories, (like inner language dyslexia, auditory dyslexia, visual dyslexia, inter-modal-dyslexia) so as to increase our knowledge about them.

In a therapeutic venture, categorisation may be attempted in order to better understand the individual and the situational constraint upon his activities. The goal is to provide appropriate therapeutic intervention.

Thirdly categorization may be done with a view to call particular behaviour as desirable or undesirable in terms of social, or cultural values and attitudes without using religious rhetoric. For illustration, does homosexuality reflect mental illness? Is it desirable or undesirable in the society?

Each of the three purposes of diagnosis have their importance and relevance. A diagnosis for further scientific knowledge must meet contemporary standards for good science. Such a diagnosis is evaluated in terms of the methods used and the results obtained. Likewise therapeutic diagnosis is evaluated in terms of diagnosis-specified treatment: How far it reduces negative behavior and increases the patient's worthwhileness, competence, attitude etc. However, empirical evidence is required to evaluate the diagnosis - specified treatment. On the other hand moral goal oriented diagnosis is successful if diagnostic proclamations inhibit pathological socially undesirable behaviours facilitate socially desirable behaviours in large segments of the population. It is of critical importance that the professional expert understa the discrimination among the three purposes of diagnosis. This understanding helps in properly evaluating his diagnosis. While the researchers will be interested

in the scientific purpose of diagnosis, the teachers, psychologists, or neurologists would be more interested in therapeutic diagnosis.

Diagnostic Models

Like the purpose of diagnosis, there are at least, three diagnosistic models, which are related to the different approaches to dyslexia described in Part I. These are: (a) medical disease model, (b) psycho-metric model, (c) social systems model.

Medical Disease Model (MDM)

Its perspective is well known, it focusses upon the assessment of attributes of a patient in a search for the causes of the symptoms (otiology). It focusses upon biological explanations for problems and cure of biological abnormalities intrinsic to the patient. A 'normal' person is one who has 'no biological abnormalities'. Pathology is an integral part of a person; social and cultural factors which may be related to etiology are ignored in this framework, organic malfunctioning is primary. The elimination of causes are supposed to provide relief to the patients Psychometric Model (PM).

It attempts to determine the abilities and skills of the child through the use of standardised tests in order to assess the inadequacies which are responsible for the child's problems. The inadequacies present may be due to many causes; one of the important causes being the slower development of one part of the brain than others, resulting in the strange array of skills and deficits as observed in learning disabled child. And that inadequate development of certain school behaviours at the preschool age predicts failure in school achievement in primary classes. This model suggests that early intervention provided to children experiencing lags will eliminate or alleviate later problems.

Social System Model (SSM)

It emphasises the environment; the postion taken is that most problems experienced by the children are attributable to the imperception, incompetence, or limitations of significant persons in their environment. Diagnosis and treatment are directed toward evaluation a change in the environment, not in the assessment of the child.

SSM calls attention to the difficulties which may result from the biases of diagnosticians, aspirations of parents, incompetencies of teachers, and the hazards

to individual welfare faced by the child when dealing with authoritarians. Thus the diagnosis of learning abilities would require the evaluation of the parents', teachers', and peers' responses to behaviours of the child.

SSM utilises Skinner's operant conditioning approach for diagnosis and intervention. The child's aberrant behaviours are controlled by the reinforcement or reward strategies of individuals in the child's environment. The model focusses attention on the manipulation of large units or samples not on intervention and assistance to the individual child.

Multidisciplinary Approach

The very heterogeneity of children with learning disabilities both across diagnostic categories and within any one category has resulted in the inclusion of diagnosticians with varying perspectives. The multidisciplinary team approach administers a wide range of medical, psychological and educational measures to the child. The goal is to determine the primary causes of the problem. The team is responsible for determining which of the diagnostic categories best describes the child's problem and which type of educational programme is best suited for the child. Once a child is assigned

to the learning disability category, other disabilities like hearing and vision impairments, emotional problems, mental retardation are presumed to be ruled out or of secondary importance.

Instead of the routine personality or intellectual assessment, neurological and psychological assessment of specific skills related to learning and academic achievement is attempted.

The professional members of the multidisciplinary team typically include the teacher, psychologist, pediatrician, neurologist, electro-encephalographer, social worker, and sometimes speech therapist and audiologist. Furthermore different professionals are qualified to do overlapping jobs. The social worker and psychologist consider 'case history' more important; both the psychologist and special education teacher are trained to administer educational and diagnostic tests; pediatrician and neurologistcan administer medical examinations. Who coordinates the team work depends upon who first notices the problem or takes the case.

THE ASSESSMENT

Neurological Evaluation

The neurological evaluation in diagnosis of dyslexia is very important to either establish or rules out the presence of specific disorders of the

nervous system and to establish developmental attainment of neurological intgracies (Clements, 1966).

The neurological evaluation is not based solely on any one type of measure, but the data are gathered from a number of sources, the case history, observation and examination. Generally measures are included which are more psychological than neurological. The Neurologists seeks to synthesise information gathered on the central and peripheral nervous system, intellectual processes, and the behaviours of the child collected from the child's developmental, history.

In America, Task Force II (1969) prescribed the content of neurological evaluation. The standard neurological evaluation includes measures of 'cranial nerves I-XII'; 'motor system' tone and strength; 'sensation' vibration, position, and touch; 'cerebellar' testing; and 'reflexes' stretch and cutaneous. The following examination procedures have been outlined in the report:

(1) Observation of the general appearance and behaviour of the child and the means by which a child attempts tasks.

(2) Double Simultaneous Stimulation of the Peripheral Visual Field: The examiner moves fingers in the child's peripheral visual areas. In this procedure examiners checks for of nystagmus or other abnormal behaviour.

(3) Check for Facial Apraxia.

(4) Check for Hearing: Final extensive hearing test may be conducted by an audiologist, the neurologist routinely checks out hearing, using tuning forks which are calibrated to different sounds and intensities. In addition two tests can be conducted with older children who can respond verbally to the examiner:

(a) The Rinne test (Curtis et. al., 1972, page 237);

(b) Weber Test (Dorlands Illustrated Medical Dictionary 1965).

(5) Pronunciation.

(6) Simultanagnosia.

(7) Performance of Repetitive Motions.

(8) Posture and Gait.

(9) Visual Motor Skills.

(10) Conception of Spatial Relationships.

(11) Right-Left Orientation.

(12) Auditory and Visual World Association and Language Usage.

(13) Finger Agnosia.

(14) Reading Ability.

Psychological Evaluation

The purpose of conducting a psychological evaluation is to assess the following processes which are important from the point of view dyslexia:

1. Visual Perception Process
2. Auditory Perception Process
3. Visual Motor Process
4. Orientation: right-left
5. Cross modality and Integrative Assessment
6. Conceptualization Assessment
7. Learning Ability Assessment
8. Language Assessment
9. Academic Achievement Assessment
10. Behaviour Assessment.

The psychologist primarily uses standard Tests but also utilises case history material.

Visual Perception Process

Spmings' Visual Perceptual Analysis Battery illustrates the kinds of tests used in the assessment of visual perceptual processes. It consists of the following 10 tests:

Test 1: Differentiation of Likenesses and Differences Among Simple, Uncluttered Geometric Forms. This test helps in assessing perceptual disorders, particularly orientation problems which occur with considerably more frequency than reversal problems in dyslexics.

Test 2: Differentiation of Likenesses and Differences Among More Complicated Patterns of Geometric Forms. In this test the forms have some relationship to each other and require more astute scrutiny.

Test 3: Differentiation of Likenesses and Differences Among Complicated Patterns of Geometric Forms. This test requires non-symbolic sequential perceptual skills in determining likenesses and differences.

Test 4: Differentiation of Likenesses and Differences Among Simple and Uncluttered Pictured Items. Pictures give meaning to the item and through the test it is possible to consider meaningfully what is being perceived, if the individual is capable of inferring meaning he will do so.

Test 5: Differentiation of Likenesses and Differences Among Complicated and More Cluttered Pictured Items. In this test differentiation is to be made among complicated designs.

Test 6: Differentiation of Likenesses and Differences in Symbolic-type Material. The symbolic type material is somewhat similar to the letters and numbers although letters and numbers themselves are not used.

Test 7: Differentiation of Likenesses and Differences Among Nonsense Words.

Test 8: Test for Visual Discrimination of Words. The level of difficulty of the words is such that reading is not a factor, but instead emphasis in on perceiving in the proper sequence and retaining the general gestalt. Visual memory is used in this te

Test 9: Perceptual Synthesis Test. This test assess the individual's ability to synthesize perceptually. Reading involves not only the ability to make discrimination among letters, syllabl and words, perceiving these in sequence, but also to make these discriminations while synthesizing and analysing.

Test 10: Perceptual Analsis Test. Through this test one is able to evaluate the child's ability to analyse perceptually and to discern the accuracy and speed with which he is able to engage in this process.

Auditory Perception Process

Springs' Auditory Perceptual Battery illustrates the kinds of tests used in the auditory perception process. It consists of the following five tests:

Test 1: Nonsocial - Nonverbal Auditory Tests

Part I Tone Discrimination

Part II Tonal P ttern Discrimination

Test 2: Social Nonverbal Auditory Tests

Part I Auditory Matching Test

Part II Auditory-Visual Matching Test

Test 3: Test of Auditory Discrimination Among Words.

Test 4: Auditory Temporal Integration Test

Part I Sound Blending Test

Part II Auditory-Visual Test

Test 5: Hearing Sounds in Words Test

Part I Initial Test

Part II Endings Test

Part III Blending Test

Visual Motor Process

The status of development of the visual motor process is assessed through drawings of a series of geometric shapes. Visual motor skills require the ability to visualise and to assemble material from life into meaningful wholes; the ability to see and to perform with dexterity and coordination; the ability to recognise part-whole relationship in working towards a goal which may be unknown at first; and lastly the ability to control body or hand movements in coordination with visual perception.

Developmental milestones for these shapes are:

scribble	18 to 24 months
circle	24 to 36 months
cross, vertical and horizontal straight lines	36 months
Square with rounded corners	3½ to 4 years
square	5 years
triangle	5 to 6 years
diamond	7 to 8 years

Orientation: right-left

By 7 to 8 years a child is expected to be able to name the left and right eye, ear, hand, and foot.

The non-verbal assessment of right left orientation is apt to be more revealing with respect to an accurate status of these skills.

Cross-Modality and Integrative Assessment.

This assessment requires: (i) visual to verbal; (ii) auditory to verbal; (iii) visual to auditory; (iv) auditory to visual. These are measures through complex tests which are described later in this section.

Conceptualisation Assessment

This assessment is done through verbal and non-verbal components of complex tests described later in this section.

Learning Ability Assessment

There is always a need to assess HOW a child learns which is quite apart from WHAT he has learned and the approach should include both visual and auditory assesment. In dyslexics, this area is more important and the prognosis in some cases can be predicted with considerable accuracy on the basis of the learning ability data. The complex tests described in the following pages provide evidence of learning ability.

Language Assessment

Three kinds of language assessment are important; (i) inner, (ii) receptive; and (iii) expressive the complex tests described in the following pages provide an assessment for the three kinds of language development.

Academic Achievement Assessment

Two kinds of academic achievements are important:

1. Reading - word recognition, paragraph reading.
2. Arithmetic - fundamentals, concepts, problem solving (oral and written).

Behaviour Assessment

Behaviour assessment can be done by both subjective data and objective data. The subjective data is obtained through projective tests like: the Rorschach Ink Blot test, the Thematic Apperception Test etc. The Objective data can be obtained through tests like: The Springs' Behaviour Rating Scale, structured Parent Interview Schedule.

SOME IMPORTANT TESTS

In India psychological tests for measuring the above mentioned processes are not known. However, in American parts of tests for use with elementary children and high school children have been developed. The following chart illustrates them. Figures , , , show possible choices for test selection at different grade levels: (a) pre-school,

(b) elementary school, (c) high school.

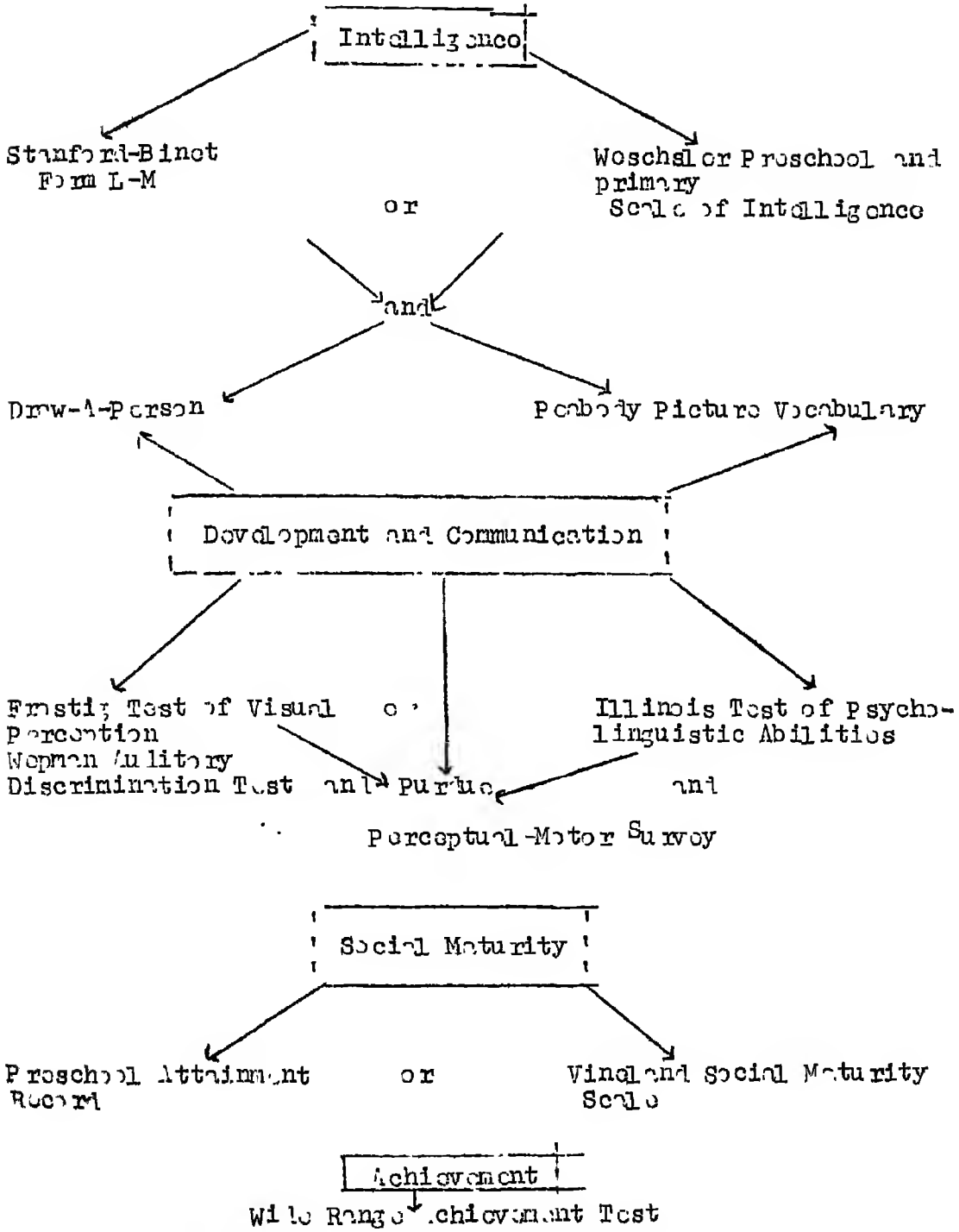

Figure . Minimum Test Battery for Preschool Children.

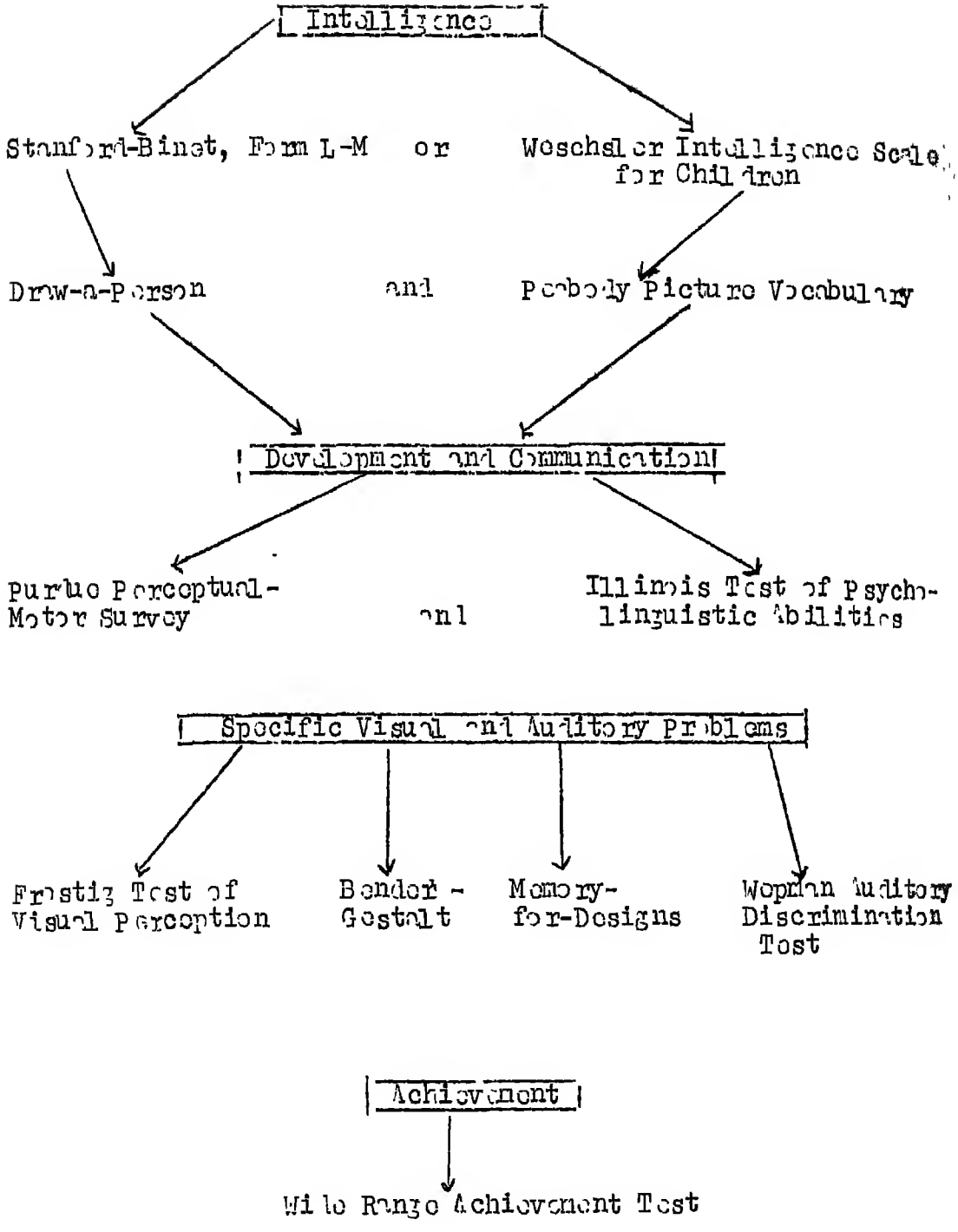

Figure Minimum Test Battery for Elementary Children.

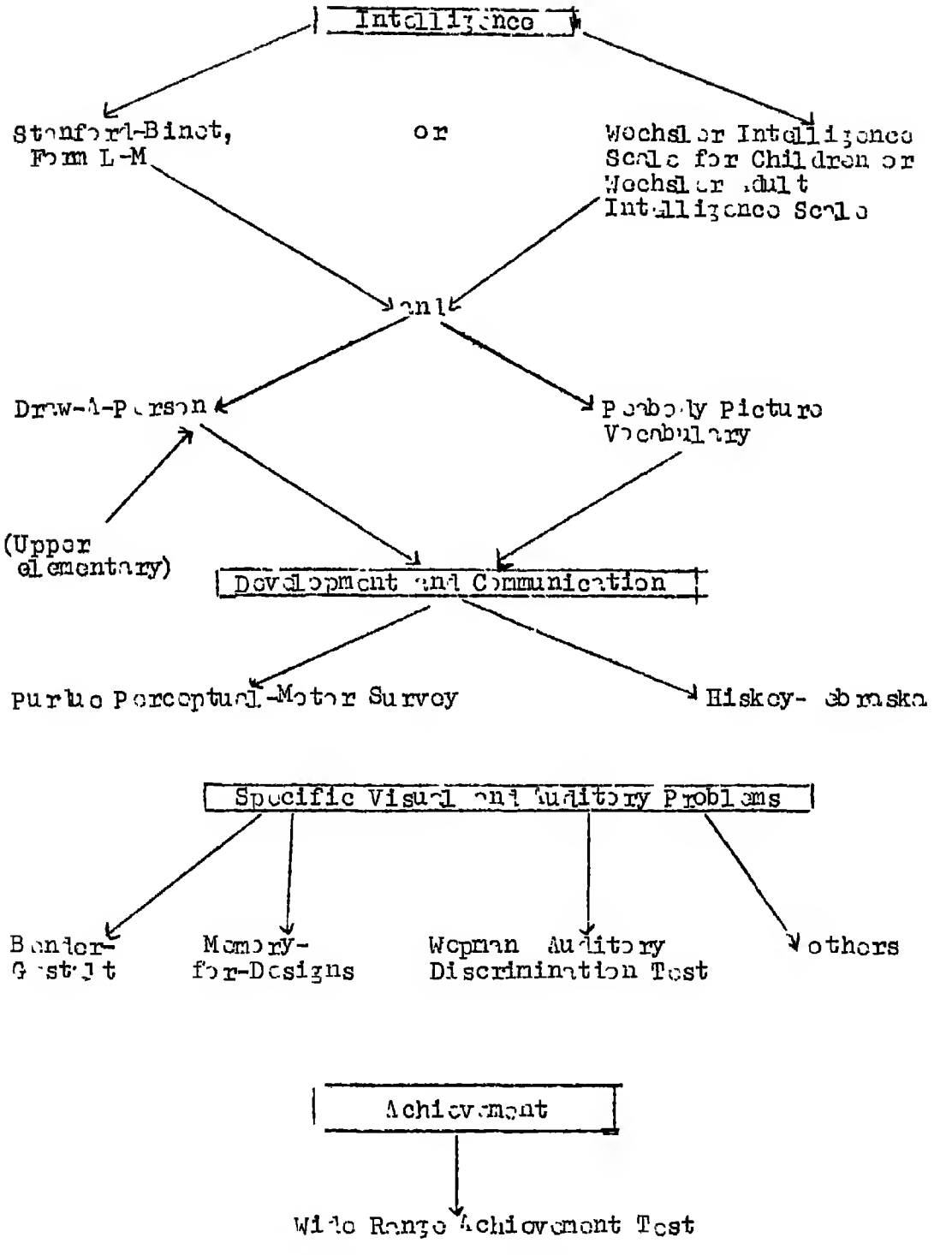

Figure Minimum Test Battery for Upper Elementary, Junior High, and High School.

Brief Description of some Tests.

Peabody Picture Vocabulary Test (PPVT): is an untimed individual test administered in fifteen minutes or less. The test booklet contains three practice plates and one hundred and fifty test plates, each consisting of four numbered pictures. The Examiner reads the stimulus word which is given on the answer sheet, and the subject responds by indicating the number of the picture that best illustrates the stimulus word.

Items are arranged in ascending order of difficulty, and the subject responds only to the items between his "basal" (eight consecutive correct responses) and his "ceiling" (six failures out of eight consecutive responses).

Scoring is rapid and objective. The examiner places a mark over the item number of each incorrect response; these marks are counted and subtracted from the ceiling score. The difference can be converted into a mental age, an I.Q., and a percentile rank.

Memory-for-Designs Test (MFD): involves the presentation of single geometric designs and the reproduction of these designs from memory. In the 1920s the inability to perform such tasks was associated with "organic" impairment, and the MFD was developed to accompany the test battery for the clinical study of possible brain-damaged patients.

The test is composed of fifteen cardboard squares on each of which is printed a single black design. The examinee views a card for five seconds. He then must reproduce the design as he remembers it on a piece of white 8½x11-inch paper.

Bender-Gestalt Test (BGT): is a maturational test in visual-motor gestalt functions. It is useful in exploring retardation, regression, loss of function, and organic brain defects, both in children and in adults. However, this kind of diagnostic exploration should be left to the trained clinician. Its use, relative to learning disorders, should be confined to visual-motor aspects. This point cannot be over-emphasized. The role of medicine is to diagnose medical diagnose medical problems, but the role of education is to diagnose academic problems.

The subject is given a white, unlined sheet of paper, 8½ by 11 inches. He views a card with a stimulus design. Then he copies the design the way he sees it. The test has no time limit, and the designs are not removed until the subject reproduces them. Memory is not a factor in this test.

Goodenough-Harris Drawing Test (DAP): is a good test of conditioned or learned responses. A child draws a person on a sheet of white, 8½ by 11 inches unlined paper. The number of details reproduced in the drawing determines the score, and the comparison of the total number of details with a normal scale determines the child's mental age. From his mental age, one can tabulate his I.Q.

Children with learning disabilities, particularly dyslexi have considerable difficulty with the DAP. Whether or not this difficulty is due to problems of self-concept, revisualization, or the inability to organize a complete structure is not known at this time.

Wide Range Achievement Test (WRAT): measures achievement in basic school subjects or reading (word recognition and pronunciation), spelling, and arithmetic computation.

It supplements tests of intelligence and of behavioural adjustments. It aids in the accurate diagnosis of reading, spelling, and arithmetic disabilities for people of all ages and in the determination of instructional levels for school children.

It consists of two levels (I and II), both of which are printed on the same length; the test can be used to examine a person twice, once before and once after the age of eleven.

Test requires only about thirty minutes.

Durrell-Sullivan Reading Achievement Test (DRAT): evaluates the child's performance in word meaning, paragraph meaning, spelling, and written recall. Careful observation and examination of the child's written response can suggest the nature of his reading difficulty. It is approximately forty-five minutes test. It provides continuous and comparable norms from one grade level to another.

Wechsler Intelligence Scale for Children (WISC): contains both the verbal tasks and the performance tasks of a child in order to determine his total or full scale I.Q. score.

The test consists of six verbal and five nonverbal or performance sub-tests: (1) information, (2) Comprehension,

(3) Arithmetic, (4) Digit Span (memory for digits forward and backward), (5) Similarities, (6) Vocabulary, (7) Picture Completion, (8) Picture Arrangement, (9) Block Design, (10) Object Assembly, and (11) Coding. The verbal subtests, 1 through 6 above, precede the performance subtests, 7 through 11.

The WISC test battery, one of the oldest and most frequently used intelligence tests, is of special importance because of the countless number of studies that have been made of it. Its diagnostic and clinical features contribute greatly to the study of learning disabilities.

Illinois Test of Psycholinguistic Abilities (ITPA):

consists of a battery of subtests to assess the important aspects of one's linguistic ability. Its design originated from Hull's formulations coupled with Osgood's psycholinguistic model. It measures three major dimentions of any given psycholinguistic ability: (a) level of organisation, (b) psycholinguistic processes, (c) the channels of communication.

"Level of Organisation" refers to the functional complexity of the organism. Two levels are important for language acquisition: representational and automatic sequential.

The representational level denotes activities that require the meaning or significance of linguistic symbols.

The automatic-sequential level denotes activities that require the retention of linguistic-symbol - sequences and the execution of the automatic-habits-chain.

"Psycholinguistic processes" specify the acquisition and use of all the habits required for normal language usage. There are three main sets of habits: reception (decoding), association and expression (encoding).

The process of reception consists of the sum of those habits necessary for the attainment of meaning through either visual or auditory linguistic symbols or stimuli. The process of association consists of the sum of those habits necessary for manipulating linguistic symbols internally. Tests that demonstrate the presence of associative ability include word association tests, analogies tests, and similarities and differences tests. The process of expression consists of the sum of those habits necessary for expressing one self in words or gestures.

"Channels of communication" indicates the sensory-motor path by which linguistic symbols are transmitted, received, and responded to.

The ITPA is divided into two parts: reception and response. Pure receptive ability requires only a mode of reception - hearing or sight. How the subject responds has no relevancy to a test of receptive ability. Similarly, expressive ability requires only a mode of response -speech

or gesture. Associative ability or any combination of abilities however, requires the interaction of all the channels of communication.

Twelve psycholinguistic abilities are tested in the 1968 edition. They are listed below:

The Representational Level

These tests assess the subject's ability to receive and interpret meaningful symbols (reception or decoding), to relate symbols on a meaningful basis (association), or to express meaningful ideas in symbols (expression or encoding).

Reception

1. Auditory Reception (Auditory Decoding)
2. Visual Reception (Visual Decoding)

Association

1. Auditory Association (Auditory-Vocal association)
2. Visual Association (Visual-Motor Association)

Expression

1. Verbal Expression (Vocal Encoding).
2. Manual Expression (Motor Encoding)

The Automatic-Sequential Level

These tests assess non-meaningful uses of symbols, principally long-term retention and short-term memory of symbol sequences.

Automatic tests make frequent use of language and its numerous redundancies which lead to highly over-learned or automatic habits for directing syntax and inflection without conscious effort.

1. Grammatic Closure (Auditory-Vocal Automatic)

2. Visual Closure (1968 edition only)

Sequential Tests

1. Auditory Memory (Auditory-Vocal Sequencing)

2. Visual Memory (Visual-Motor Sequencing)

Supplementary tests (1968 editions only) for purposes of remediation.

1. Auditory Closure measures the perceptual interpretation of any sound when only some of it is heard.

2. Sound Blending measures the communication of sound blends by determining how well the individual is able to blend together the sounds he hears.

The Purdue Perceptual-Motor Survey (PMS): is not a test but a survey which enables one to observe a broad spectrum of behaviour within a structured, but not stereotyped, set of circumstances. It is designed primarily to detect rather than to diagnose perceptual-motor development on the basis of a series of behavioural performances.

It consists of 22 scorable items, divided into 11 sub-tests, each measuring some aspect of the child's perceptual motor development. Basically these subtests are concerned with laterality, directionality, and the skills of perceptual-motor matching.

From this survey, the clinician may discover subtle areas of weakness that perhaps cannot be detected through tests of linguistic abilities.

PMS cannot be used with children having specific defects such as blindness, paralysis, or known motor involvement.

Hiskey-Nebraska Test of Learning Aptitude (HTLA): is designed primarily to evaluate the learning ability of deaf children. This test has five subtests for psycholinguist abilities that supplement ITPA in assessing the linguistic weaknesses of older children.

Five subtests are administered to children in the age ranging 3 to 10 years:

Bead Pattern

Memory of Color

Picture Identification

Picture Association

Paper Folding.

Seven sub-tests are administered to children of all ages and are useful in discovering learning disabilities.

Visual Attention Span

Block Patterns

Completion of Drawings

Memory for Digits

Puzzle Blocks

Picture Analogies

Spatial Reasoning

Marianne Frostig Developmental Test of Visual Perception: measures five specific areas of visual perception (1) Eye-motor coordination, (2) Figure-ground discrimination, (3) Form constancy, (4) Position in space, and (5) Spatial relations.

Wepman's Auditory Discrimination Test: helps to identify children at the early elementary level who are slow to develop auditory discrimination. The test also makes a differential diagnosis of reading and speech difficulties in older children.

This section has provided an overview of the typical procedures in the initial steps of a dyslexics, neurological and psychological assessment. Brief description of some important standardised tests has also been provided. It is obvious that the procedures and tools vary according to the children, their parents and their assessors. But the procedures and tools to allow for the flexibility often needed when dealing with others. They have stood the test of many years of implementation and apparently are necessary for an adequate understanding of the child.

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